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History of Science and Technology Program

RESEARCH AND DEVELOPMENT IN RADIO AND ELECTRONICS, 1915-1974

Harold H. Buttner

An Interview Conducted by Arthur Lawrence Norberg

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Harold H. Buttner

1975

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ACKNOWLEDGMENT

This interview with Mr. Harold Buttner is one of several dealing with the development of electrical engineering and electronics within the larger series of oral histories produced by the History of Science and Technology Program of The Bancroft Library.

Besides these interviews, the Program assembles other primary source materials, including the papers and personal memorabilia of scientists and engineers, and the papers of certain organizations with which they were associated. The information in the papers and interviews helps to demonstrate not only the development of science and technology in the western United States, but in the nation as a whole.

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James D. Hart
Director
The Bancroft Library

INTRODUCTION

This interview with Harold Buttner was recorded February 5, 1974. It was conducted and edited by Arthur L. Norberg, as part of a series dealing with development in radio engineering and electronics. Mr. Buttner's work as a Navy radioman and long association with Bell Laboratories, Western Electric, and ITT encompassed many of these developments.

The final document was prepared with care from the original tape-recorded interview. A preliminary transcript was edited for clarity and sense, and the original tape checked against the resulting draft. Occasionally it was necessary to rearrange paragraphs and/or eliminate repetitive sections and superfluous questions. The edited transcript was then submitted to the interviewee for further clarification, identifications, and, in some cases, additions. The index to the transcript was prepared by Marie L. Herold. Mark J. Haas, Marie L. Herold, and Ann L. Pfaff-Doss aided in the final production of the transcript.

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Oral history can frequently provide useful information on subjects not easily retrieved from published sources. Hence the questions often dwell on family history, social and economic conditions affecting research, interactions with colleagues and peculiarities of institutional organization. They can also elicit useful data on scientists' perceptions of themselves, their colleagues, and their discipline. With respect to the historical record, oral history ought therefore to be taken as a retrospective first approximation, a starting point to organize research for corroborating data in sources contemporary to the events described or to gather hints about possible relationships, influences and sources that might otherwise be overlooked. It should be borne in mind that the interview records what the interviewee remembers during the interview about what happened at a given place and time. Typically, many years have passed since the events occurred; selective memory (and sometimes wishful thinking) may have had ample time to operate. In general, information obtained in response to broader questions is more likely to be accurate, albeit more difficult to corroborate, than answers on specific events, influences, and accomplishments.

The user wishing more detailed contact with this or other interviews in the History of Science and Technology series may consult the rough edited drafts of the typescripts and/or listen to the original tapes. Tapes are located in The Bancroft Library's Microforms Division; draft transcripts, in the papers of the History of Science and Technology Program. Either may be ordered through the Heller Reading Room.

Robin E. Rider
Head, History of Science
and Technology Program

CURRICULUM VITAE

HAROLD H. BUTTNER

1892 Port Costa, California, born November 3
father: Louis N. Buttner
mother: Mary Hendry Buttner

1915 University of California, Berkeley (B.S., electrical engineering)

1916-17 Radio Engineer, U.S. Navy Department

1917-1920 Serviceman, United States Navy

1922-23 Expert Radio Aide, U.S. Navy Department

1923-26 Radio Engineer, Bell Telephone Laboratories

1926-30 Employee, International Telephone & Telegraph Company

1930-36 Managing Director, International Marine Radio Corporation, England

1936-40 Assistant Vice-President, International Telephone & Telegraph
Company

1940-51 Vice-President, International Telephone & Telegraph Company

1945-51 President, Federal Telecommunications Laboratories

1951-57 Vice-President of Research and Development, Federal Tele-
communications Laboratories

1957-70 Member, Board of Directors, Hewlett-Packard Company

1958-78 Consultant, Federal Telecommunications Laboratories

1970-78 Emeritus Member, Board of Directors, Hewlett-Packard
Company

1979 Bridgeport, Connecticut, died January 12

Date of Interview: 5 February 1974

Preliminary on the Hewlett-Packard Company

Norberg: This morning we are at Hewlett-Packard Company. I'm talking with Mr. Harold Buttner, formerly of International Telephone & Telegraph Corporation (ITT), consultant to Hewlett-Packard and on the Board of Directors here.

Buttner: Correction: I'm now an emeritus.

Norberg: Emeritus member? Is this recent?

Buttner: Just recently. Fred Terman and I were made emeritus. I was made emeritus first, because I felt I was too old to be on the Board, and when Mr. Packard was in Washington, well, I just said I didn't want to be elected again. So he said, "All right, don't go away." Next thing I knew I had been elected emeritus, which is just a wonderful gesture on the part of Hewlett-Packard.

Norberg: Does "emeritus" mean that you keep coming to Board meetings and take part in...

Buttner: Oh, yes. Nothing changes. And in this company, the fact that the emeritus Directors do vote is of no consequence whatever, because we don't have any situations here in which the voting of the Directors is all important. Matters are so well thought out and discussed beforehand that voting by Directors is a routine procedure.

I've been around a long time, and in lots and lots of companies (I still have an office in ITT in New York) and Hewlett-Packard is the best-run company I've ever seen. They have had a practice of looking in the future long before anybody else. Long before it became fashionable Hewlett-Packard was treating their employees well. Hewlett-Packard has always had a sense of obligation to the community in which they were a part. It is now very popular among all the companies to do these things, but Hewlett-Packard has been doing it here right from the very beginning.

Norberg: Can you say something about what motivated that?

Buttner: Well, just fine people. That's all. Fine people are always well motivated, and have a sense of responsibility, and realize in the measure that they have achieved power, that responsibility increases.

- Norberg: Well, that suggests, though, that other companies were not composed of fine, upstanding men when these gentlemen were beginning, doesn't it?
- Buttner: Well, you could say so, but they weren't advanced to the degree, they didn't look as far into the future as... They probably reflected more of the older days of, where the first job, and the only job, really, of running the company was to make the thing profitable and if to make it profitable you had to grind down the employees a little bit, why, they'd grind them down, and they had a sort of a sense of small concern. You can't generalize like this, without getting into trouble. I think this was so. It was so marked in this case, and naturally contrasts in my mind with the situations that were. The first place I realized it was here. Without getting off the track here, did you read a book by a fellow named [Anthony] Sampson, an Englishman, on ITT, The Sovereign State of ITT?
- Norberg: I tried to find that book yesterday, and I must confess it's not in our library.
- Buttner: Well, you should get it.
- Norberg: I will.
- Buttner: It's well written, it's full of misstatements, but there's a great deal of fact in there about the early days. He made it sensational, for obvious reasons.
- Norberg: Tell me, as a way of getting into the interview here, how did you become associated with Hewlett and Packard?
- Buttner: In the very beginning, I met them through Charlie Litton. You know Charlie Litton? Charlie was one of my very oldest, greatest friends. And at that time I had various assignments in ITT, among other things, Chairman of the Patent Policy Committee. The Vice-President and Patent Attorney were not interested in the business side of patents, an important phase of the business as ITT held all foreign rights of Western Electric patents, hundreds in number. So because of its importance, a patent policy committee was formed, the chairman being President of ITT. Nobody could object to that; and then he turned the thing over to me as the chairman. So, I was concerned with all patents and trying to get royalties from people who were using our patents or using the Western Electric foreign patents.

Hewlett and Packard developed an oscillator, resistance-capacity oscillator. It was quite good, and it seemed like it would be a good idea to have the foreign rights to that.

Buttner: So that's the way the thing started, and then later ITT acquired the foreign rights covering the Hewlett oscillator patent. They omitted the payment and these were times when it was touch and go here with Hewlett-Packard so the small payment was all important.

Norberg: Now, who forgot to pay?

Buttner: ITT. And so this was a small amount of money; it was also an important amount of money. Someone, either Bill or Dave, called me up and said, "Can you do something about this?" I said, "I'll see that ITT pays right away." An important matter for Hewlett-Packard at that time.

Norberg: You go ahead.

Buttner: Well, anyway, this did relate to my introduction to Hewlett and Packard.

Before U.S. entry in World War II, we had association with Dr. Hansen of Stanford who had done outstanding work on the klystron, high frequency generator tube. Ultra short waves were important for war work, particularly radar. The French heard about work in the U.S. on the klystron and so through ITT's French company, asked if we could arrange to get rights under this, and, hopefully, manufacturing information. Sperry gyroscope company had acquired the patents from Stanford for this important invention. So I went to see the President of Sperry, who at that time was Gillmor, and told him of the situation. The French government was very desirous of having these rights, and considered the matter all important. Gillmor's reaction was that Sperry won't talk about licensing anybody at that time. However, in an issue of the Review of Applied Physics, a picture of this klystron appeared. So I got in touch with Charlie Litton and told him of the urgency of the situation; that the French considered vital. I asked Litton, "Can you make one of those things, Charlie?" He said, "Well, somebody did. Sure I can make it." So he made a klystron. I followed the work closely, and the result, actually it was better than the one Sperry made. Ever since then I've made periodic visits to Cal.

When it got about time for me to retire from ITT, David Packard was in New York one time, and he invited me to lunch, and he said, "What are you going to do when you retire?" Well, I hadn't even thought about it at all. And he said, "Why don't you come with us? I think you'd have a lot of fun." I said, "I could answer you 'yes' right now, not for the reason you think, but because I just like to be associated with a live bunch of young people. That's just what I want, so I'd be delighted." So that's how I came here.

Education in California

Norberg: Before we pursue that further--and we will--can we go back to Port Costa? Can you tell me something about your family?

Buttner: Yes. My grandfather came here from some place in Kentucky, and his people came from Frankfurt in Germany. That's my father's father. My mother's father lived here in San Francisco and came here from Scotland. He had a marine engineering business. My grandparents lived here all their lives. My father was born in Sunol. Do you know where Sunol is?

Norberg: No.

Buttner: Do you know where Niles is? Livermore?

Norberg: Yes.

Buttner: All right. Sunol is the head of the Niles Canyon, which is about eight or ten miles from Livermore. It's a place which we still own, incidentally, as a part of my grandfather's homestead. It was on a range of hills near the former home of Phoebe Apperson Hearst. So that's my grandparents on both sides. My grandfather on my mother's side, I never saw; he died before I was around. My father worked with the Southern Pacific and he became County Treasurer of the County of Contra Costa. He died quite young, in his forties, when I was just starting college. I went to college at Berkeley, and graduated from there in engineering.

Norberg: Can we not proceed quite so fast, though. What did your father do for the Southern Pacific?

Buttner: Well, he was employed in the division area in Port Costa.

Norberg: Was he an engineer of some kind before he went to the railroad?

Buttner: No, I think he was more in the accounting-administrative side. He was not an engineer.

Norberg: Did he go to college locally?

Buttner: No, I don't know how far he went through school. Not very far. He was sort of self-educated, then he became County Treasurer, and then we moved to Martinez. And at that time, that was my first experience with electronics, called wireless.

Norberg: What year was that?

Buttner: It was 1910. 1906 was the year of the earthquake. We were living in Port Costa then, and by 1910 we moved up to Martinez. And then we were trying to get telegraph signals with galena silicon and electrolytic detectors.

There was a group of people around the Bay here: Ralph Heintz was one, and Charlie Litton, when he came in at that time, a fellow by the name of Wiley, and they later formed what was called the Bay County Wireless Association. Haraden Pratt was quite active in that. Incidentally, I made his acquaintance by wireless long before I ever met him in college, and the same way with a man named Lewis Clement. And you would talk over the wireless, and later you finally met.

In those days they passed a law specifying the frequencies [that] amateurs, what they called wavelengths at that time, could operate on, and power. No limit at all. You just picked a spot where you seemed to get good radiation in your antenna, and what power you could afford. We made our own transformers, and this was a curse too, for the neighbors, because the high frequency got back in the line and short-circuited lights around the country; the sparks made a terrible noise, and [had] a lot of power in some of them. Clement, I think, had a ten-kilowatt transformer. His father was a civil engineer, and he had a special line put in by PG & E, because the local lighting circuits were inadequate for the power required.

I had problems even then. I was hard of hearing. The first time I realized it was when I realized that I could not hear the Honolulu station on the headphones. A measure of achievement was reception of the Honolulu station, and I never could hear it. So some of the boys came over to my house. "Hell, there it is. You don't hear it?" So I realized [it] then, and I've been cursed with defective hearing ever since, in varying degrees.

Norberg: Well, how did you get involved with wireless in the first place? What was your first experience with it, do you remember?

Buttner: Well, I suppose there was a firm down on Market Street called Paul Siler. He had a few wireless gadgets. And then there were small magazines with semi-technical articles. That's how I got first acquainted with wireless, and it was very simple. The equipment was just a variable inductance coil, a detector, and a pair of headphones.

Norberg: Did you wind the coil yourself?

Buttner: Oh, yes. We had to make our own transformers and did all that. That was the first introduction to electronics, then called wireless. Of course we amateurs were a nuisance to the coast

Buttner: stations, too, because they're all over the place, frequency, and some of the boys took particular interest in the station out there on the beach. The coast station was unable to communicate with the ship when the boys would interrupt and complete the communication, which was not appreciated.

Norberg: How powerful was your set?

Buttner: Oh, about a kilowatt and a half. Before we got to the point of transformers, we were working with spark coils, spark coils with a mechanical interrupter. A better performance could be obtained with an interrupter, which was called an electrolytic interrupter, with a sharp point in a porcelain tube projecting into a bottle of sulfuric acid and water. Hydrogen bubbles would form on that point where it stuck through the tube, and that would interrupt the current. It made a terrible noise, and it spread sulfuric acid around. So that wasn't too popular with the families involved, and that didn't last long. But then the ability to make high-voltage transformers came along--small wire and bit cores--and then everybody had those. These things were just a very short passing phase.

Norberg: When did the regulation of one kilowatt come in?

Buttner: Hoover law regulated power and frequency.

Norberg: But do you have any idea about when? Was it when you were in college, perhaps?

Buttner: It could have been then, or just shortly after.

Norberg: Okay. I'm trying to fix the date down, and some of the routines.

Buttner: They could have that of course, you could pick that up very quickly, that's a matter of record.

Norberg: Yes, but I'm trying to get some of the discussions that went on before the regulation came in. We can fix the date all right, but why and how is not recorded.

Buttner: Why, of course, as more and more young people got involved in this home wireless, why, the conditions were getting chaotic. They were all over the place, they had powerful stations, and they were just as apt to light on a frequency they liked right near a coastal station frequency, and they were calling them on their own frequencies.

Norberg: Okay, that's after 1918. Isn't that after the First World War? About that time?

Buttner: That's right. That would check up pretty well. I'm pretty sure it was during the period when Herbert Hoover was Secretary of Commerce. And then from that followed the necessity to have a license, and for that you had to develop a certain degree of understanding, and pass a very simple test in Morse Code or Continental Code. And some of the people at that time, Pratt and several of them, Clement, a number of those were in the association around the Bay here, would get summer jobs as wireless operators on ships. I couldn't do that because my hearing was bad; I'd get a job on the steamers and oilers. So then when we went to college, Pratt, Clement, myself, there were three of us who were really interested in it, wireless. At that time the Campanile was just being constructed. Professor H.F. Fisher suggested that we do our thesis work on wireless communication. So then we started working on that. One of our first projects was to determine the longitude of the campus by receiving Arlington signals using the high Campanile structure to support a long antenna. And we did write such a thesis! It's around some place, I suppose, if they keep those things. Do they?

Norberg: Not senior theses, no. The problem with space is just too monstrous.

Buttner: I suppose so, yes. Well, anyway, that was a...

Norberg: Do you have a copy of it?

Buttner: No, I don't have one. I've lived a terrible life. I've been here, there, everywhere, and I don't have anything. I've lived in London, I've lived in Paris, went back and forth across the ocean with ITT and over a long time. We were married many years before we owned anything that wouldn't fit in the steamer trunk. And then we finally located in Rye, New York. We lived here for a short time too, in San Francisco. So I didn't keep any. I had a complete set of the Institute of Radio Engineers, I gave that to my associates here at Hewlett and Packard.

Norberg: Okay, before we talk too much in detail about Fisher and wireless communication on the Berkeley campus, how about your high school years? What kind of courses did you take in high school?

Buttner: Well, I went to a high school in Crockett, called John Swett High School. I took what was normal courses at that time. I took a little bit of Latin, physics, chemistry. I was pretty good in physics and chemistry, and on the whole, I guess I was a satisfactory student there. I really liked those things, and the very fact that we were playing with wireless gave added incentive to...

Norberg: Was the physics instructor involved in wireless too, do you remember?

Buttner: No, I don't think so. I think it was a lady. The first encouragement in that direction was when we went to the University. As a matter of fact, my father, having died young, I had to make my own way. I did various things: I wired houses, I installed motors, then in my senior year I got a job with the Assistant to the Dean correcting papers, et cetera.

Norberg: Do you remember the decision of going to UC and studying engineering?

Buttner: Well, the engineering decision was mine, going to UC was my father's decision. As a matter of fact, he didn't have the advantage of a college education, and wished for his two sons to enjoy one. It was all understood; you do well in high school and go to UC, and then my brother the same thing, came along five years later. And so I was always interested in the engineering. I have an interesting anecdote which we may cut out of here.

Norberg: Go ahead.

Buttner: When I was in college I had to work all the time. During first year engineering there was a summer camp of surveying. It was a required course which you paid a certain amount of money for. You did surveying problems in the field, and then you did all the calculations that go along with them, and the usual things, running levels and traverses. But it was mandatory to pass summer civil engineering camp before graduation. So I stayed, I didn't go. I worked, and it went on and on and on, and it came at the end of the last year. I knew Professor Derleth, who was a great man, great engineer, he was Head of Civil Engineering, and I asked if I could have the opportunity to talk with him about this particular problem. "Oh," he said, "I'd be very glad to. Why don't you come up to my house on Sunday morning for breakfast?" So I came up there, and we had a grand talk, just a pleasure to listen to him. We were just getting along beautifully, [I thought] I won't have any problem here when the time comes. And he said, "Now, by the way, what did you come here to see me about?" "Well," I said, "Professor Derleth, I came here on this summer camp of surveying," and I gave a quick rundown on the reasons I hadn't gone. He said, "You don't have any problem at all." He said, "All you have to do is make up your mind whether you're going to go to the summer camp of surveying this summer or spend the rest of your life explaining to people why you didn't graduate." So that avoided all discussion. I remember that so well.

Norberg: Did you go to the summer camp?

Buttner: Yes, I did.

Norberg: Tell me about the engineering program at UC. What were the various steps involved?

Buttner: Well, the engineering program was the usual for the first couple of years. It's quite a bit of mathematics, physics, and you didn't really end in drawing, freehand drawing, and descriptive geometry form of drawing. And we had civil engineering course, we did a certain amount of surveying on the campus. And we had a chemistry course, which everybody liked, from a Professor Lewis, a great man. And good mathematics courses.

The engineering wasn't really much. Looking at it today, we were learning a lot of practical things, never had any reason to use. We knew how to make a boiler test, and we could go into a power plant and presumably measure all the inputs and get a heat balance where all the heat went, and a conversion, and come up with an efficiency. And we could do the same thing. We made tests of efficiency of motors, et cetera. First we had a pattern shop run by a very interesting old gentleman, who was named Cox, and it was a man to look back on. He was a wonderful pattern maker, and that's what he was; he was just a pattern maker. He didn't have any idea other than just to see that you made good patterns and teach you how to make them. If you didn't make them good, as I remember, he had a habit of looking at it, and then he'd spit tobacco juice on the masterpiece. And then we had the machine shop, which I found useful in later life. We had hydraulics and mechanics under Professor Le Conte, a really great man. That was a privilege. There was a man that you'd have to be awfully stupid not to learn with him, just an inspiring guy. And then in the higher mathematics, there came differential equations; there was a Professor Baldwin Woods, young man, and he and his wife became great friends of ours, way after. I still see her. He died very young. Well, those were great courses, remembered well.

Norberg: Were there any electrical courses being offered at that time?

Buttner: Yes, the Dean of Engineering, Clarence Cory, gave an electrical course, and then they had a very bright mathematical theoretician named Pernot. He was great on the theoretical calculations in electrical engineering. And I remember when we had one way of making a little money. He was making logarithm tables, addition logarithms, a lot of computation. He was a wonderful man and organizer. We learned a lot, you know, it was free. We shouldn't have taken any money for it. But you go in there and work a few hours on these calculations, and his course was theoretical. Professor Cory's course again was a little too much on the practical side.

Norberg: What did it involve?

Buttner: Well, a lot to do with rates. That was where his great outside activity, he was a well-known man in the economics of the electrical industry and he was called in as an expert often, so he gave us quite a bit of that. He had a brother who was a great civil engineer, built the Aswan Dam.

Later in my career, I was President of the ITT research laboratories, we had a number of French engineers. You could see the difference in the education of the French engineers and our people, because we knew how to solder everything, how to make things and all that, but when it came to derive a formula, or do something from first principles, they excelled. You know, these Frenchmen would sit there, discussing something, and they could just work it out from first principles; most of the American engineers have to go to a handbook.

Norberg: Do you remember any of the textbooks that you used?

Buttner: I don't want to hazard a guess, because I'm not sure. I did miss one man. We had a course in thermodynamics there with Professor Sibley, a well-known man, and he ran a good course. He's a great professor. So that was good, practical, if you were working in that area of the business, I mean. You really understood the fundamentals of thermodynamics.

Norberg: Who else was in this class with you?

Buttner: Well, there was Pratt and Clement, these two fellows that I had previously mentioned that were in wireless communications, and a young man from Honolulu named Bush, Gavien Bush, and...

Norberg: Do you remember a man by the name of Laird, Kenneth Laird?

Buttner: Yes, oh sure.

Norberg: What can you tell me about Laird?

Buttner: Not much, because I never had any contact with him after college. He was closer to Clement. I do remember him quite well.

Norberg: Do you remember about how many people were in the engineering graduating class?

Buttner: Oh, I guess forty. They had a Japanese man who was very good there, can't think of his name now. There was a fellow named Barnes.

Norberg: Let's go to the radio course, or the radio activity on campus. Can you tell me the details of that?

Buttner: Well, there was nothing much to do. First of all, it was getting the wire on top of the Campanile. Pratt did that personally! He went up there. The fellow liked to be climbing for some reason around down at the gymnasium, you always saw him up around the roof. He climbed the Campanile, let a string down, pulled up a rope, a heavy rope, finally got this husky piece of copper wire, and then came the question of a good receiver, getting a good detector. That was just prior to the time amplifiers were being developed.

Norberg: How much equipment was involved? Really very small?

Buttner: Yes, small amount of equipment.

Norberg: Who was the faculty member, again, who was involved in that?

Buttner: Professor Fisher.

Norberg: Do you know what happened to Fisher after you left?

Buttner: Well, he left the University to [become a] consulting engineer. I never have personally had contact with him after I left college, although Pratt did. Pratt saw him from time to time.

Norberg: How close was your association with Pratt?

Buttner: Quite close. 'Cause we had this mutual interest in wireless. He lived down on Lombard Street, 1510 Lombard Street, which was just a great expanse of sand and their house was--this was before the fair, 1915--the only house there.

Clement, he was in better financial circumstances. He got a very nice house in the Lake Merritt district. Pratt's father was a musician. He played the organ during the World's Fair in 1915. He was the official organist at Festival Hall, and Pratt was quite a musician himself. Then afterwards, Pratt was quite active in the Institute of Radio Engineers and became President, and member of the Board of Governors, or President, and up to the time he died, he was quite active in the [profession]. Oh, he always had some concern, it was one of his real interests in life.

Navy Radioman

Norberg: When you were coming out of UC in 1915, what were the job prospects for you?

Buttner: We were known on the small wireless wire. Marconi Company was building the transcontinental, transoceanic circuits from here to Honolulu; enormous towers were built at Bolinas and Honolulu. Mr. A.H. Ginman was General Manager, an Englishman. And he got in touch with me and with Pratt and with Clement and offered us all a job, and that sounded pretty good. And just about that moment, one of the men who had been in class with me had just made a trip to the Orient on the Pacific Mail Steamer, S.S. Korea. I thought that would be a great idea. At that time there were no unions or anything. One just walked down the dock and got a job on a steamer and signed the articles.

So I decided that I'd do that and I did get a job. So I went over there working in the engine room. That's very enjoyable. And now, then being a young college guy, you had all sorts of ideas of what you could do. I had it all arranged to set up to measure the torque of the screws, but the chief engineer had a pretty dim view about that. And I had methods of determining the leaking gas, ammonia gas from the refrigerators. His general motto was, if it's working, leave it alone.

When I came back I needed a job, so I got in touch with Mr. Ginman. I went over to his office in San Francisco. "Oh, well," he says, "yes, Mr. Buttner." He says "In May I, so and so, I wrote you a letter, didn't I?" And I said, "Yes, sir." He said, "You didn't answer that letter did you?" I said, "No, sir." He said, "Supposing you go home and answer that letter and then come back and talk to me." So, I didn't do that. I heard from Pratt, who'd gone to the government up in Mare Island, there was a position up there, what they called an expert radio aide, and a lot of activity going on up there. The Navy really doing a lot of things up there, So I went up there and got a job and didn't follow up Marconi.

Years later I was in London as managing director of one of ITT companies, and I went to some official dinner and I was introduced to various people and I was introduced to Mr. Ginman. I said, "I met you before." And he said, then I mentioned, "Oh," he said, "I remember that very well."

Norberg: How about the Navy activity in radio?

Buttner: That's quite important.

Norberg: Let's go into that in some detail.

Buttner: About that time the Poulsen arc was developed by Poulsen in Denmark, and the advantages of continuous waves over the sparks were beginning to be generally recognized. The Navy

- Buttner: showed great interest in continuous waves. The U.S. rights under Poulsen patents were obtained from Denmark by Mr. C.F. Elwell of California acting for a group of U.S. businessmen, eventually incorporated as the Federal Telegraph Co. in Palo Alto. A series of arc continuous wave generators were developed, 5W, 10 and then 30, then 100 and then 500 then finally they ended up with thousands of small arcs. There is available a good book on this general subject.
- Norberg: Who is the author of this book, while you have it out?
- Buttner: Well, his name is Maurice Deloraine. And he joined the ITT in about 1922 or '23, and he was technical director over in Europe. Here read that.
- Norberg: Why would he be giving you credit for that?
- Buttner: Well, because I made it.
- Norberg: What did you have to do with it?
- Buttner: Well, I made the suggestion to Behn.
- Norberg: Can I stop for one minute, the recorder doesn't know what we read. There is a statement in Mr. Deloraine's book about the magnets that were given to Lawrence at the Berkeley Radiation Laboratory for the 27-inch cyclotron and Deloraine credits this gift to Mr. Buttner.
- Buttner: Having told Colonel Behn, who was the president of ITT, that this would be the chance to do something really good with them rather than just selling them for junk, which would have cost us money to get them off the premises. ITT owned Federal at that time. There's a picture of Behn.
- Norberg: Now what was the involvement then of Leonard Fuller, who was at Federal at the time? Did you have any contact with Fuller in regard to these matters?
- Buttner: Oh sure. Fuller, then Dean of Engineering at...
- Norberg: He was Head of the Electrical Engineering department, yes. But he was still a Vice-President with Federal, was he not?
- Buttner: I don't think so, it was after. I'm not sure. I don't want to make a statement I'm not sure of, but I don't seem to recall him. He might have been a Vice-President of Federal, but he was never...

- Norberg: He was, that's right, not of ITT, no. So, did Fuller make the approach to you and then you made the approach to Behn? Is that the sequence of events that you remember?
- Buttner: No, I don't remember Fuller at all. That's sort of hazy about it.
- Norberg: I see.
- Buttner: Well, this was being talked about here when I was coming out here with Charlie Litton and other people and we're sort of vaguely aware of what was going on. I don't know what was the genesis of the idea of... One thing probably had a great deal to do with it, the pictures you saw of the cyclotron looked a bit like this 1000 kilowatt of ours.
- Norberg: Oh, yes. Do you know that that casing is still up at the Lawrence Hall of Science?
- Buttner: Yes.
- Norberg: Okay, but we got into this now when you were mentioning the Navy's involvement with the Federal arcs building up to 1000 kilowatts. Let's get back to the Navy and their involvement in radio.
- Buttner: The Navy planned a world-wide communication using these arcs. And they had one in Sayville, Long Island. The one in Long Island was one taken over from the Germans where they had a Telefunken alternator there. And, Annapolis, Panama Canal, Manila, Honolulu, Samoa wasn't so big as some others. I put the one in Samoa, incidentally. So that was the real activity in radio at that time. Of course, RCA was quite active in their work and you're familiar, I won't take your time...
- Norberg: Go ahead. I want to know what you're familiar with.
- Buttner: Well, as a matter of national policy, we were concerned with the British controlling our communications. The Marconi Company had then developed the vacuum tubes, had made the short wave stations. The high frequency alternator was developed by Alexander for G.E. Alternators were installed in a couple of places on the East Coast. The British offered to buy them, to get the rights for them, and that would have given them control of our communication. The Navy was very much concerned. The Navy had a lot of power there.

Then there was another question, some patents were held by Marconi and some were held by the RCA, and General Electric and Westinghouse. At the suggestion of the Navy Department,

Buttner: the RCA was formed and they got rights from Westinghouse, they got rights from G.E., and that's really how RCA came into being. So then, having that happen, why then the British no longer had an important foothold in any communications here.

The Poulsen arcs were in all these places I mentioned, but the Poulsen arcs had some bad features. The radiation was not clean and pure and there were all kinds of harmonics and they bothered the coastal station and obviously that couldn't continue. I remember we had one in Sayville, big one, and it interfered with the New York stations and there was... This was just about in the moment of the start of broadcasting. I had read some patents by Campbell, a famous telephone company engineer, covering filters.

Norberg: We're discussing the Navy and the Sayville station.

Buttner: Yes, well...

Norberg: Formation of RCA... What were the duties of an expert radio aide in 1915?

Buttner: Well, one, for instance, we were working on amplifiers and we were testing various insulators. Most insulators weren't much good at that time, particularly for continuous waves, as they overheated and disintegrated. We were doing that and planning circuits for installation on the various Navy ships. We were working with radio goniometry, and developing circuits, installing them on ships and calibrating them. Every year they had an expedition to Alaska; there were a lot of Navy stations in Alaska. And a group of people from Mare Island Navy Yard, including a couple of expert radio aides, went up there and overhauled everything--the generators and antennas--so they'd be good for another year. And the year that happened, when I was there, why they had the job of installing an arc in Samoa. So they gave me the choice to go to the Alaska one or go to the Samoa. I thought it would be fun to go to Samoa. I was there nearly a year.

It was an interesting thing to this extent, that they decided to place the station in Pago Pago harbor, Tutuila, Pago Pago harbor is in a hollowed-out mountain, a volcano at one time. It has an opening to the sea and thousand-foot or more cliffs all around. There was no way to know whether electric losses through these mountains would preclude transmission. They didn't want to put it up on the top of them because that would be a beautiful target from the sea. So, if it were at all possible we wanted to put it down in the harbor. So that was the general idea: to take it down there, install it temporarily, down below put it up with wooden towers,

Buttner: three-hundred-foot tower, build an antenna and an extensive ground system. And, if it worked, all that was asked of it was to communicate reliably to Honolulu. But then finally we installed it. So we got it installed and it not only worked to Honolulu, it worked to San Francisco and even to Annapolis.

The old governor was just delighted there, everybody was very pleased and so I went on, my job was finished. "Oh," he said, "no, no I'd like you to stay and put the permanent one in." I said, "No, Governor, that's not at all necessary, it's going to take a long time. There won't be any material here. We got to get concrete from the States and anybody, all they have to do is just connect up the wires the way they are now, they won't change anything." And he said, "No, I'd like you to stay." And he said, "I've wired the Secretary of the Navy." I was a civilian, you know, I didn't have to stay. I said, "Well, what will I do. I won't have anything to do for months." "Oh," he said, "I'll make you a member of my staff." So I was a member of his staff. I went around to the various islands calling on the natives and had a life of Riley, swimming and fishing and I lived on the station's ship in the Captain's quarters, because he had a house ashore. So that was a very pleasant duty. And then war came and I wanted to enlist, and by that time was in very good graces with the Governor and his executive staff and they said, "Well, we'll make you a Naval officer right here on the spot." But hell, I couldn't pass the physical examination, my hearing, so that was the end of that. And as soon as the station was finished, I came back here.

I joined the Navy then as an enlisted man. They didn't care whether you could hear or not. So, and then I got assigned to a steamer, it was called the Baron de Kalb, it was carrying troops across the Atlantic and it was interesting, because you always wondered whether a torpedo was going to come through the side. In the meantime, at the request of General Pershing, it was decided to build a powerful radio station in France, so Army communication would not be dependent upon submarine cables vulnerable to Germans. Federal Telegraph Co. was commissioned to build two 1000 K.W. arcs. The Navy was designated to assemble an organization to build the towers and install the stations.

There was a man named A.M. Stevens who was a Stanford graduate from Palo Alto. He had been an expert radio aide and was commissioned a Lieutenant Commander and put in charge of the project under a regular Navy officer. Stevens sent a query to Navy personnel, as they wanted me on that job. I was an enlisted man on U.S.S. de Kalb. I was transferred ashore to Bordeaux, France, under orders to go to the projected station, later called Lafayette Radio Station. I was assigned

- Buttner: there all the time the station was being built, and then when the station was finished and the war's over, why, everybody went home. I was given the choice of staying there and finishing the station as the American representative and becoming a Lieutenant junior grade where I would eventually get the Légion d' Honneur, or I could be demobilized right then and get \$10.32 a day. Well, I decided for the \$10.32 a day and stayed there until the station was finished and turned over to the French. And that was the history of that.
- Norberg: Did you know Lieutenant Commander Sweet?
- Buttner: Yes. Because he came to Mare Island. He was very concerned with radio communication. And then there was a man named, quite well known in Navy communication field at that time, Stanford Hooper. Stanford was probably from Stanford.
- Norberg: Let's drop back for a few minutes. What else do you know about A.M. Stevens?
- Buttner: I know him very well because I was up in Mare Island when he was there. And then he was the man chosen in charge of the installation of the station. He worked with Federal, incidentally, right here in Palo Alto. At that time, Dr. de Forest worked with Federal and invented the triode vacuum tube there. And it was by virtue of him working here that Federal and ITT had shop rights under de Forest patents, which gave them a point of departure against RCA, which had a nearly ironclad position on their patents in the field of vacuum tubes. So that was the reason that the Mackay system, controlling the Postal Telegraph commercial cable, bought Federal in order to get these rights. Mackay realized if they were going to get anywhere they had to be able to have some sort of radio communications in competition with RCA. And then later ITT acquired the Mackay system.
- Norberg: How does Stevens fit into all of this?
- Buttner: Well, Stevens fits into this in this way, he was one of the leading, he and Pratt I would say, were leading expert radio aides at Mare Island. He had charge of installations of the big arcs at Cavite, and Honolulu, and the Canal Zone. Stevens had been associated with Elwell earlier when Elwell built a radio station in Ireland, Ballybunion, Ireland, shortly after acquiring Poulsen rights. That's how he got into the picture as far as Federal was concerned, and then, as I say, he had the electrical charge at Bordeaux, the big arc stations.
- Norberg: I see.

Buttner: And let me see what happened to him. Then I lost track of him when I joined ITT, and then I finally got him an assignment with ITT in Argentina.

Norberg: Yes. Yes, died before this project began, unfortunately.

Buttner: Yes, he knew a lot of the early days at Federal. His wife still has a great collection of documents and...

Norberg: Do you know where she lives?

Buttner: Oh, yes. She was one of my wife's closest friends. She is still in the house where they lived together and he had a room full of these things, all kinds of pictures, documents of all kinds.

Norberg: Where is this house?

Buttner: It's in ~~Man~~Maroneck, New York.

Norberg: Now, do you think that we might encourage her?

Buttner: I can give you her telephone number.

Norberg: Please do. I wonder if she would be willing to give the documents to The Bancroft Library? As part of the Project?

Buttner: I can't answer for her. She's very anxious that they not be lost, she appreciates that.

Norberg: That's good. That's the the first... I will call her. Can I mention that I talked to you about this?

Buttner: By all means, yes.

Norberg: Okay, fine. Now.

Buttner: I've been mentioning it to her a number of times that something ought to be done about it. And he was just wonderful. When we were in Bordeaux in this radio station he was busy making drawings and things, when he shouldn't have been doing that at all. I learned that very early in life from Professor Derleth who gave us this civil engineering course. It was a famous theory in strength of materials called the Theorem of Three Moments. We have a beam fastened here and it's fastened here and there's a load here. It's a very involved calculation and he was just explaining the whole thing. He said, "I won't calculate, as a matter of fact, I can't, but," he says, "I can get plenty of people at \$250 a month that can." So that was Stevens' trouble, he just was always concentrating on the wrong

Buttner: things. That was his trouble in ITT also and he, as I say I've seen him, the last couple of years he hasn't been well, he's been sort of [suffering from] arterial sclerosis. I tried to get him to do a few things to make a little money for him and write something, but what I wanted was two or three pages, a general thing, which he knew, but he'd end up fifteen pages on one small detail.

Norberg: Was he in need of money at this time?

Buttner: Oh, no, but he could always use it, something that never seemed to be in surplus.

Norberg: Let's go back to the difficulty with the arcs. When the previous side of the tape finished you were just beginning to describe the difficulties with the Poulsen arc and you were talking about the radiation effect, the harmonics. Can you elaborate on the difficulties with the arc as you people in the Navy saw them in the 1919...?

Buttner: It was inherent. There was only one possible solution that was very expensive and also wasteful of power: it was to make a filter, a low-pass filter which would keep everything out. I made one of those in the Sayville station, oh, the coils were enormous things and it did some good. The arc was a very great CW generator, and probably would have persisted longer if the much more superior vacuum tubes didn't come along, 'cause they had so many advantages in size, purity of radiation, controllability of circuits. The arc was, in effect, a sort of clumsy operation. It oscillated in accordance with the capacity and inductance that were connected to it.

Norberg: When did vacuum tubes begin to be used in wireless radio communication?

Buttner: Well, when we were still in Mare Island in 1915, '16.

Norberg: How extensive was their use compared to the Poulsen arc?

Buttner: Well, not much as transmitters. More as receivers at that time. The de Forest tubes were being introduced fairly largely as receivers and detectors and even as oscillators and this gradually grew up. RCA made some, G.E. made some, and they were rather limited in power, 50 watts, so on. And then the first powerful ones were made by Western Electric, the Bell system, and these were the first water-cooled, copper-anode water-cooled.

Norberg: Do you remember the year?

- Buttner: Yes, it's about '23. And we were making transmitters, first water-cooled transmitters using water-cooled tubes, of course, for the Navy.
- Norberg: This was Bell Labs?
- Buttner: Now, this was Bell Labs. It was then called the Engineering Department of Western Electric. And I was working on that project. To keep the thing in a sort of continuous [story], when I finished the job in Bordeaux, I didn't have any job. And I stayed there and spent what money I had and then I came back and I didn't have any job and didn't have any money either.
- Norberg: This is 1922?
- Buttner: Yes, '21. So in 1921, I went back to the Navy and then I got a job overnight. I was working for the Navy and then I was an inspector for the Navy up at the General Electric works where they were making the first vacuum tube transmitters for the Navy battleships. These transmitters were made up of a number of 50-watt tubes.
- Norberg: What constituted your job as inspector? What did you have to do?
- Buttner: Well, you had a lot of specifications that had been drawn up for these and you had to see they followed the specifications. You had to carry out tests, make sure they made the power outputs that were laid down under the specifications. That sort of thing, general workmanship.
- Norberg: Who could draw up the specifications to begin with?
- Buttner: That was the department called the Bureau of Steam Engineering down in Washington, which later became the Bureau of Engineering and in there they had a number of these expert wireless men, expert aides from the East Coast.
- Norberg: Do you know any of those people?
- Buttner: I doubt if I could recall their names. I remember the greatest shock in my life, you know, just living and working here getting these instructions from Washington. You think that these men are right up from Olympus. And then when I went there and met some of these fellows, I thought, are these the people who tell us what to do?
- Norberg: Could you make any judgment of their specifications? Were they good?

- Buttner: Oh, sure, they worked. As good as anybody else could do at the time. There was, of course, an evolutionary process; they made mistakes and these things burned off and they changed that. That's one of the things that happened in the test, too. You write some specification, hopefully, and then the material will meet the specification and you change it so it will.
- Norberg: Were they dealing with a previous model, or was this all theoretical development at the Bureau of Steam Engineering?
- Buttner: Well, probably the development was really being done by the industrial people. They were in their laboratory, the General Electric Laboratory, for instance, and Westinghouse. They were well aware of the potentialities of this wireless business and they were looking for business. The Navy was interested in such a size transmitter and this would be offered, such a transmitter based on the normal electrical specifications.
- Norberg: So, you were with General Electric making these tests?
- Buttner: But working for the Navy. So then, how'd the devil I get out of that?

Service at Bell Laboratories

- Norberg: Well, we were trying to get to the Bell Lab's position that you subsequently took.
- Buttner: L.M. Clement, whom I mentioned was one of the classmates here in California, was an engineer with Western Electric Engineering Department. Broadcasting was just coming along, now you begin to see the amazing break in the first station there in 463 West Street. And they were hiring some engineering people. So he told me about it, and I made an application and I got a job there. And that's how I got connected with Western Electric. And the first job I had was designing a 50-Watt vacuum tube broadcast transmitter. Incidentally, there's another man here that you should see: Harold Friis.
- Norberg: No, I don't know Harold Friis.
- Buttner: Oh, yes. Harold Friis. He worked here for a while as a consultant. And Harold Friis was connected with some of the very earliest work in the Bell Laboratories in communication. Oh, he's gotten every kind of medal that can be awarded by the IRE, and the Franklin Institute. He developed some very important measuring techniques and theories of wireless transmission.

Norberg: Does he live here in Palo Alto?

Buttner: Yes, he lives right down on Arastradero. He just moved out here as a matter of fact.

Well, let me get back. I guess I had this job here and at the suggestion of Western Electric we could take one of these vacuum tubes, as a matter of fact a 5 kilowatt, and make a transmitter that would be a really great transmitter. So I got the job there. Testing it is pretty, just working with not too much knowledge, just knew you had to have 10,000 volts or whatever it was d-c on them and in the normal circuits of inductance capacity and coupling and all that. I was working in the room with that. They didn't have any sockets made for these tubes yet, so they were sitting in a bucket of water on a wooden frame with a hole in it. You put them down like that and you had the wire. So I was getting along fine, getting great results and this man came along and stood there a while. He said, "I want you to stop all that. Shut all that down." I said, "Why should I shut it down?" I said, "If anybody's going to get killed here, I'm the one, I don't see it's any of your business. Why don't you just run along and do your work while I do mine." So pretty soon I get a call from the Senior Vice-President, a great man. He said, "You haven't been here very long, have you?" I said, "Well, no." He said, "Well, as a matter of fact, Crosby, that was the safety expert, had just been up and said you should be fired." And he said, "Obviously I'm not going to fire you, but... You're in the Bell System, these safety fellows, they carry a lot of weight. You just can't send them off on their way."

So, anyway we finished this transmitter and I went down to the Caribbean on a battleship while we tested it and the officer in charge said, "I don't want you to come down there. We've got to learn this and the way to learn it is don't have somebody standing over your shoulder. If we want you to help, we'll call you. In the meantime, enjoy yourself." So I had a nice cruise down there for a couple of weeks.

Norberg: But before we go into broadcasting, can you be a bit more specific about the details of this project? What was involved in the experimentation that you were doing?

Buttner: Well, what we were trying to do was to get a higher power transmitter, capable of transmitting telegraphy on the frequencies that the Navy used. And the obvious way you do that is to get higher power vacuum tubes and these 5 kilowatt ones were just orders of magnitude more.

Norberg: Now how did you go about modifying the old tube or designing a new one?

- Buttner: Well, you just started right out with this new one so you were working with the components capable of handling more power. Essentially, that was why it was being done the way it was being done, experimentally, in a big room.
- Norberg: Well, maybe I'm not asking the question properly. How did you come upon this design then?
- Buttner: Well, there's certain fundamentals.
- Norberg: What are they?
- Buttner: Well, the fundamentals are, you get a vacuum tube with a grid and plate, put a voltage on it, it's coupled to an inductance, a capacitor and then you provide a way for energy to be fed back in and then you got an oscillator. This one wasn't even a master oscillator type of thing. It was a single oscillator, which meant that its frequency stability was somewhat limited.
- Norberg: Was there a way to get around this frequency stability limitation?
- Buttner: Yes, later they put in a little master oscillator which energy from that went into the grid into the next stage and this master stage could be nicely stabilized as to temperature and the constancy of the materials and their coils and so on.
- Norberg: Was that developed at Bell Labs, too?
- Buttner: Well, that's been a matter of controversy. I think there have even been patent suits on that. Armstrong came to prominence about this time. Armstrong claimed to be inventor of the oscillator, which resulted in a very lengthy suit with RCA, which Armstrong subsequently won.
- Norberg: Okay, what other work was being done at Bell Labs at this time, do you recall?
- Buttner: Well, of course, at that time, just about that time, my work was going on to make the electrical phonograph. All the phonographs at that time had a mechanical movement that embossed, engraved these discs and the Beil System at this time introduced the use of electrical members in which the final recording needle was driven by an electromagnet and this in turn the energy was picked up through a microphone and amplified. They used the telephone technology and just simply the final application was an electromagnetic actuation of the engraving needle. And in doing that, it was a far more of an engineering thing than that because all these things were calculated so the various members matched one another

Buttner: and you got a nice smooth transmission. Electrical phonographs were orders of magnitude better than the old mechanical ones. And that was being done there largely by Fredericks.

And of course much work was being done on telephone repeaters. In the last analysis, a repeater fundamentally was much the same as a transmitter, radio transmitter. So they brought in a great accumulation of engineering background so when the Western tried to make a broadcasting transmitter they were working with a lot of things they knew all about. Their embodiments were different, the sizes were different. Westinghouse and General Electric were working in the field, but Western Electric people were the best. Because they knew more about it, it was right in their alley, and the transmission of sound and the conversion, mechanical.

Norberg: Now I can see why General Electric and Westinghouse would be looking into these problems because they would merchandise the ultimate electric phonograph. But how was Bell and Western Electric involved in this? Were they marketers too?

Buttner: Well, really, the best way to explain it is this. This is a natural thing. In the Bell Laboratories at that time the engineering department was to investigate all new phenomena with fundamental desire to improve the technology and ultimately direct it in the direction of their business, telephony. Well, nobody knew whether this radio stuff might be very valuable, and it was for a while. There was a hard core of old-time telephone engineers thought it was for the birds. There's no question about that. It was just the younger people who saw any possibility. But nevertheless, they didn't neglect it. So as a result of this work, why they came up with the best transmitter. It was put in the West Street building, 463 West Street, and then they put another one down in the long-lines headquarters. They were the best transmitters in New York City. And simultaneously they were building good amplifiers that went with it and a good reproducer which was in the shape of a big cone. At a certain point though, the telephone company realized that this really wasn't their business. Broadcasting is political in character and they weren't going to be peddling radio receivers, that was for sure. And they weren't going to get into this transmitter for a long time. They sold these transmitters. So many of the transmitters that were made by and around the country, were made by the Western Electric Company.

Norberg: Why do you say it was political?

Buttner: Well, it still is.

Norberg: Political in what sense then? Maybe that's what...

Buttner: Political implications of it. I mean you have the potentiality of this thing in politics.

Norberg: Okay.

Buttner: All right. It's easier this way. That's foreign to the telephone business. The telephone company has been very wise in sticking to the telephone business. So as soon as the powers that be realize that here we're just going deeper and deeper into something that's not our business, sell it, get out. That's what happened. So then I installed a lot around here, KFRC, down in San Francisco, in Los Angeles, KRC, KGW, Portland. Oh, I had a grand time on those, doing that. Well, to show you how this policy has been followed...

Norberg: I'm sorry but I'm still a bit confused. You were around installing these. Was this when you were still with Bell Labs?

Buttner: Yes.

Norberg: Okay.

Buttner: 'Cause we, the source of all the know how was right there in 463 West Street...

Norberg: I understand now.

Buttner: And about that time simultaneously, you asked what they were doing other. They were making powerful loud speakers. We put in these at I think it was a convention in New York first time they ever used loud speakers for addressing an overflow audience and then they began to go in buildings. And I put one in here in San Francisco auditorium and in a synagogue. The synagogue had a hard wall and hard ceiling. Little was known about amplified sound then. Tried to put the speakers back here and the microphone there then of course the sound came back to the microphone, why you had the usual troubles. Now they have many little speakers so they don't... Well, anyway, so they had all those things going on and on top of that a great deal of theoretical work in electronics. We were a very powerful organization even then.

Norberg: When they went about selling these things what was the process, do you have any idea?

Buttner: Yes, I did it. The general process was to do a negative selling job. Explain to a prospective customer that it's a very expensive business to be in. It'll cost a lot of money

- Buttner: to set up a studio and everything, but if you insist, here's a transmitter, and here's a microphone and the amplifiers go with it. We sell it. 'Cause they weren't you see, commercially oriented. And it didn't have a great support down on 195 Broadway either.
- Norberg: Well, who's they now?
- Buttner: The AT&T and they were after all, so with the...
- Norberg: But now selling the development work on something like the electric,--I was about to say stereo set, but that's not what we're after here--the electric phonograph, how would that be handled?
- Buttner: The rights were sold to RCA Victor, and they just got out of that business.
- Norberg: But what kind of deals were made under those circumstances?
- Buttner: I don't know. I wouldn't want to say.
- Norberg: I'm looking for whether it was a straight sell out, or whether there was...
- Buttner: I don't know, it's a matter of record but I don't happen to know what...
- Norberg: Who else was there at Bell Labs at that time, besides yourself?
- Buttner: Well, one of the outstanding men there was M[ervin] J. Kelly, who later became President of the Laboratories. And it was through Kelly's far-seeing policies that the transistor was developed. And he was probably the great constructive force they've had in decades in the Bell Laboratories.
- Norberg: In what way?
- Buttner: Well, he was great leader of research and he knew what he wanted and supported his people. And he was willing to pursue theoretical paths without knowing just where they were going to lead, but always in mind that the job is improved technology applicable to the telephone. As a result of his encouragement of Shockley and Brattain and other people, the transistor was a revolutionary success. In 1910 silicon crystals were known as detectors, but what Shockley and Brattain did was to subject the whole subject to a very rigorous analysis and realize what was going on. They realized that materials were essential and that the geometry of single crystals must be known. So that was a great contribution I think on that part of the Bell System.

- Norberg: Who else beside Kelly was there?
- Buttner: There's a host of them. A man named Glunt, Joe William Glunt.
- Norberg: Glunt?
- Buttner: Ralph Bown, he's still around. This man Friis, I mentioned before.
- Norberg: These were all people there in '22 to '25?
- Buttner: Nicols, an Englishman, and then there were several Nobel prize winners there. One named Williams. I wouldn't attempt to tell you because it's a matter of record that they had at least two or three Nobel prize winners there.
- Norberg: But that must come later, doesn't it?
- Buttner: Well, it's those people around then. They were being encouraged and...
- Norberg: Did you work with any of these people you have mentioned closely.
- Buttner: Kelly, 'cause he was the father of this vacuum tube I was telling you about. He was a great leader, tough, but very great. And he got more results than I think anyone else there. The man that preceded him was a good administrator and I guess a good telephone man. There's a fellow named Colpitts that's there, whose name is known in the literature. And then there was a fellow named Black and the inventor of reverse feedback, which has played such a tremendously important part in everything nowadays in electronics. H.S. Black was one of the people there.
- Norberg: Can you compare the Bell Labs with other industrial research laboratories of that period?
- Buttner: Well, I suppose G.E. wouldn't agree with this, but those were the two great laboratories. G.E. probably imagined they were the greater. And they did cover a wider horizon, but in their area, I think that Bell Laboratories were superior.
- Norberg: What made the Bell Laboratories so effective? Because it really is the best industrial research laboratory, regardless of what G.E. will say.
- Buttner: Well, I think one of the things it does is effective here, they encouraged good people, treated them well when they came there. They realized they were going to be able to work on what they

Buttner: wanted to work, within certain limits. You associated with people of the same character and quality. Then they had the advantages of being in a big area, big center where there's lots of advantages that you don't have in small towns. The management were sympathetic, wages weren't terribly good, but they were good for that time.

International Telephone and Telegraph Corporation

Norberg: What about the decision to move to ITT?

Buttner: That came about in a roundabout way. I was in California and supposed to go back to New York, I'd finished some job. I was doing some work here and this was sort of pioneering in that, using these technologies, radio technology, radio transmitter technology, we were having some success transmitting telephone over high-tension lines. And we installed on the Georgia Power Company, between the downtown substation and the Tallulah falls generating thing. The system worked very well and then they decided they'd try to put one in the Pitt River, I got that assignment. At the Pitt River and the Vacaville station nothing could be heard over the lines except noise. After a continuous period of failure, I came to see Harris J. Ryan, the famous Stanford professor, and told him of our noise troubles. These lines were two hundred, hundred fifty thousand volts.

Norberg: 165.

Buttner: Yes, all right. I talked with Professor Ryan about the noise troubles. Professor Ryan said, "I know exactly what causes it. It's corona, the corona discharge results in the lines producing an ambient of noise which would require much power for intelligent transmission. We were working with 5 or 10 watts. That's all you needed. It's impossible to figure what you'd have to have, but you knew we needed a lot more than we did. So we got busy and we made a big amplifier right here, borrowed the stuff from people around. And then I borrowed what they called a type C telephone system, a carrier system from Pacific Company, that gave you a four to one advantage by a single side band, so we installed that there and got it in successful operation.

Norberg: Wasn't there already a carrier current line? Or system for amplifying carrier current on that line?

Buttner: No. Not on the Pitt River. Other people were working with it. I think General Electric. So again the Bell System felt that the commercial exploitation wasn't their business, and the final job was turned over to G.E. You were dealing at a disadvantage thru Western Electric Corporation as the power companies are the customers of General Electric, Westinghouse. It's kind of a merchandising business anyway. So that was it, they finished that. So I was out here on something else or other, and I didn't go back as fast as I should have.

Some friends of mine were going up to Lake Louise so they said, "Why don't you come up? Take the steamer up the coast." They had these fast steamers that you probably wouldn't remember them. The Great Northern Railway had two beautiful fast steamers than ran from San Francisco to Seattle, and the trip to New York was completed by railroad. I got back to Western Electric several days late. My boss said, "Where've you been?" I told him, and he said, "You didn't let me know now, did you?" "No, I didn't think about it actually." And he said, "Well, I was going to fire you, but I'm not going to, I got something worse. The International Telephone and Telegraph company have the idea that they can connect Cuba and Puerto Rico by telephone. Behn, the President, has been hearing the Puerto Rico radio stations in Cuba all the time and the people in Puerto Rico had been hearing Cuba, and so on. So he believes he can put in a radio station to connect them for some hours a day. ITT consulted with the Bell Laboratories on the subject, and we're going to send you down there."

Dr. H.T. Friis of Western Electric Engineering Department (Bell Labs) was a world authority on radio transmission. His opinion was that radio noise would be the determining factor. Once you know what the noise is, you know what the power has got to be and then you may calculate how powerful the transmitter must be. So Dr. Friis was the first to appreciate the role of noise in radio transmission. Friis designed equipment that measured the absolute value of noise. That may have been the first time I met Harold Friis. And I got my briefing and I went to Cuba to make these tests. I did not see Behn, but went to Cuba in a hot month, September. I went to the outside plant near Havana and commenced the tests. It was just as obvious as could be, there wasn't a Chinaman's chance of putting a circuit in with any chance of success.

I was supposed to go to Puerto Rico and do the same thing, but the results were so conclusively negative, there was no use wasting time and money going to Puerto Rico. So I folded up goods and went back to New York, called Mr. Behn's office and told him I had the report. Well he said, "I'm pretty busy now." He said, "Can't see you now, but why don't you

Buttner: come to the Lafayette Restaurant about half past eight tonight?" He said, "We'll have a nice dinner. We can talk about it then." So he was very understanding, and that was that.

And shortly later he called up and offered me a job with their engineering department. And I told him, I appreciated the offer, that he knew so little about me. I said I'd been with the Western Electric and I've just got to the point now where I'm worth something to them. I don't think it would be the right thing for me to pull out now, much as I'd like to. So I continued there. By that time I was married.

I was out here doing some work in carrier telephone and my wife and I were living in Jackson Street in San Francisco. She was a very brilliant woman. I got my yearly raise; it was three hundred dollars. She said, "You're not going to get very far if that's what they think of you, \$300." She says, "300, 600, 900 and why don't you take that position with ITT?" She said, "There's a coming company, growing, and you may be much better off there and certainly find it interesting." Well that's the way it turned out. I may not have been as fortunate at Bell Laboratories 'cause people that really got some place there, in most cases are Ph.D.'s and I only had a B.S. That's true today. So anyway, that's how I got to ITT. So then I constituted half of the New York engineering department. There was another fellow with a little background in telephony.

Norberg: Who was he?

Buttner: Keefer, his name was Keefer. And then we were just starting the Paris Laboratories. Some of that's in this book here. I was there for a while and I was in Argentina, Spain, and Cuba, and then I lived in England for a while. So it turned out to be a very satisfactory...

Norberg: What was the differential in wages when you went with ITT? Did they offer you a substantial increase in your salary or your position?

Buttner: No, I don't think so. But I think the offer was just sort of intriguing, a growing outfit going places. If one is any good at all in a growing outfit, he has very much greater opportunities.

Norberg: What made you see ITT as a really coming outfit?

Buttner: Well, all you had to do was to talk to Behn for five minutes. He had great vision and eventually justified most of his visions. He saw many times too far in advance. We put in short

- Buttner: wave connections between Spain and all the South American countries, connecting with ATT here, long before it was commercially feasible; technically feasible, yes but financially successful, no. It was through his vision that we put in, with the ATT on a fifty-fifty basis, cables between Cuba and the mainland of the United States. So, he's always been a person that looked a long way in the future, an inspiring guy.
- Norberg: This was Sosthènes Behn wasn't it?
- Buttner: That was it, the older brother was more a flywheel effect. His name was Hernand. And so, I got very close with them all these years and it was a very satisfactory arrangement.
- Norberg: Can you tell me something about Sosthènes Behn?
- Buttner: Well he was one of these fellows that's sort of nature's noblemen, you know. He'd walk in a room and no matter how many people were in the room, nearly all realized that personage had arrived. I don't know why; it was sort of an intangible. Go into a restaurant, instantly all the waiters, head waiters, come to pick him up. He never was ostentatious in any way. He just had a certain presence that I don't think anybody else had. He was probably the greatest connoisseur of food and cigars and wines I ever met. And that's one thing he did for us, in that we learned to appreciate good food and drink. He had a dining room in the penthouse of 64 Broad Street, New York. Each day he had a formal invitation lunch with 12 to 22 guests. The lunches were magnificent. You went when you were invited. And then you could be pretty sure when you're going to be invited. But one thing too, you soon found out, was that if you were invited and didn't go, then it would be two weeks before you'd be invited again. So it's more or less a command performance. The State Department used to ask him to entertain distinguished visitors because there was no place in New York where you could give them such outstanding cuisine. It was a very great thing for us, 'cause of all these important guests and inspiring conversation.
- Norberg: Wouldn't this be to the company's advantage as well?
- Buttner: Certainly. I think the company was well served. To give you an example of a lunch meeting. After World War II, the Japanese sent over an official delegation, the first official Japanese delegation. There were high dignitaries from the Japanese Foreign Office and representatives of the Military and the Navy. Admiral Halsey had just retired and he joined ITT. He was President of the cable company, which was always a sort of an embarrassment to him that he said he didn't know

Buttner: anything about the cable business. Behn said you know about men, that's what's really important.

Well anyway, the State Department asked Behn if he would have these Japanese for lunch. Behn always arranged to protocol so that Admiral Halsey was superior and Behn a subordinate. Behn advised the United States State Department that if Admiral Halsey agrees, we'll have them. So Admiral Halsey said that'll be fine. And so they generally worked out a system with a big table like this and Admiral Halsey and the Colonel and the guests of honor. Turned out the guests of honor sat next to Admiral Halsey and the Japanese were having trouble with conversation as they generally did a few years ago. So in this particular instance, there was an embarrassing situation. Suddenly this Japanese dignitary turned to Admiral Halsey and said, "Have you ever been in Japan?" Admiral Halsey's answer was just what you'd expect from a great man. He said, "Yes, as a matter of fact I have." He said, "When I was a midshipman in Annapolis we took a midshipman's cruise to Japan."

Norberg: Very nice.

Buttner: Wasn't that a nice thing to do? And you can imagine though what his people told him when he left. Well.

Norberg: Let's get back to how Behn ran the company.

Buttner: Well, it was a one-man company. We had some very great people in there, because having bought the Western Electric Company's foreign interests, we had some very fine Western Electric people. And this I can tell you as a continuation of the statement I made that the Bell System always knew what their main business was. They had this very profitable international network of factories, no operations, but all factories, in practically everywhere. And Behn got the contract for rebuilding the Spanish telephone system. So he had to have a factory; he had to have a source. And Automatic Electric wouldn't cooperate, there was no way to get that. The chances of building up or something were pretty slim; it takes so long.

Just happened at the right moment he approached the AT&T. Would they sell their foreign interests? They said they would and it was \$25 million which was dirt cheap, and with all these factories, trained people, reputation with the British Post Office, so on. So the arrangements were made in the sale of Western Electric International. The President of Western Electric was opposed and wouldn't sign the contract. At that time the President of AT&T was H.B. Thayer. Thayer said, "Well, that's a detail." He said, "If you don't want to

Buttner: sign it, I'll sign it." Western Electric was a wholly owned subsidiary of AT&T. So that's the way it happened. J.P. Morgan Company financed Behn, and the contract was completed. That was the making of the ITT.

Norberg: What did Behn have before that?

Buttner: Well, he had the Cuban telephone company which was making money. He had shown AT&T a bit of his own ability when they jointly laid the cables between Havana and ITT had the name, the Puerto Rican telephone company. And that's about it.

Norberg: That's about it. So when they bought the Western Electric foreign interests, that became a real international company.

Buttner: He also had a contract with the Spanish government to rebuild an entire telephone system. That needed a factory.

Norberg: Did Western Electric have a factory?

Buttner: Not in Spain, but they had plenty of people. That's pretty well covered in this book here too.

Norberg: Now what did you have to do when you first came to ITT?

Buttner: Oh, I guess I went to Cuba and did some work down in Havana on the telephone system. ITT also had a radio broadcast station there which was later sold for the reason, a radio station would be very political there, and not compatible with a public telephone business.

Norberg: So once you went with ITT, you got away from the engineering aspects of radio telephony.

Buttner: To a certain extent. No, not exactly. I was more in the management side of engineering, because when the war came on in 1941, why we set up a laboratory in this country. C.M. Deloraine brought some Frenchmen engineers to the U.S. to get the lab started. Later I became President of the laboratories. The organization became quite a very fine research laboratory; did a lot of pioneering work in communication.

Norberg: Was this the Federal Telecommunications Laboratory?

Buttner: It was at that time, yes.

Norberg: Well, now in 1928 or so, didn't ITT acquire Mackay, which had already acquired Federal?

Buttner: That's right.

Norberg: Now, do you remember the takeover of Mackay? What were the reasons involved?

Buttner: Yes, I think I mentioned it earlier. The really important thing was the shop rights under the de Forest patents.

Norberg: But that would put them into domestic activity as well as foreign, wouldn't it?

Buttner: That's right, and they would no longer be dependent on RCA. RCA had taken a very arrogant attitude, as they controlled the field with the principal patents. They wouldn't sell anything and they threatened suit if you used their radio circuits. They were maintaining a monopoly, or trying to. So by buying Federal, and with that came the shop rights, vacuum tubes were covered by the shop rights of the fundamental de Forest patent. So that was really the reason 'cause the Mackay system was a kind of a broken-down affair which eventually fell apart.

They had a telegraph system across the country much smaller and less important than Western Union. Western Union, as time has proven, wasn't so great either, but [what] they had what was even worse. Mackay had some telephone offices in the center of certain large cities. Mackay had telephone circuits composed of wires the size of a lead pencil. If one wanted to make a call, say from Chicago to New York, he could go to the Mackay office in Chicago and telephone somebody who had been previously advised to appear, and you can see what that amounted to. And it lost money right along.

Norberg: Were the shop rights, let's say in 1930, all that valuable?

Buttner: Yes.

Norberg: I would think developments would have gone so far beyond your original...

Buttner: Well, they still had this pretty fundamental patent. It's hard to get around that for a while.

Norberg: I see.

Buttner: Now there's such a multiplicity of patents it would take five years of litigation to know.

Norberg: I'd like to refer to a couple of your comments in a speech in 1930.

Buttner: Did I ever make a speech?

Norberg: Oh, yes. It was subsequently published.

Buttner: I don't recall that I made any speeches. I was sort of a master at dodging them.

Norberg: Well, this one was made. It was published in Electrical Communication. But that was excerpted from the Proceedings of the...

Buttner: IEEE?

Norberg: IRE, I guess, although that doesn't seem right. But anyway, it was in Electrical Communication in April of 1931. There are two comments that I'd like you to expand upon, if you can remember the details. One of those is that you said the following, "There are those that believe that the future of radio is exceedingly limited and will be largely confined to broadcasting and communication with and between mobile stations, where, of course, the use of wires would be impossible." What gave rise to such a thought in this period?

Buttner: I didn't say that I thought that.

Norberg: Oh, no, you were attributing this to others.

Buttner: Yes. Well, I guess what it probably was. At that time radio was subject to a lot of interruptions, so it wasn't as reliable as wire circuits. And probably the fact that the real powers in the Bell System, the communications people, didn't believe in radio. So always the people working in radio in the Bell System were on an uphill business. Radio was just sort of tolerated where nothing else would do.

Norberg: This is in 1930?

Buttner: Yes. We all realized that.

Norberg: The second point, "There are even those that believe that the wire interests are making a concerted effort to gain control of radio in order to stifle its growth and to overcome the menace of radio to the wire communication systems of the world." Now, who would be doing this buying? Was this a criticism made of ITT?

Buttner: No, I hope not. Was I working for them then?

Norberg: Yes. This is not you. You are still talking about somebody else.

Buttner: Oh, yes, yes.

- Norberg: Now, were the people who were criticizing ITT for having bought Mackay.
- Buttner: Undoubtedly. The RCA probably was among them. That was a threat to their monopoly.
- Norberg: But, can you remember the detail of this at all?
- Buttner: Why I made those remarks? No, I don't think I can.
- Norberg: I'd like to go on to perhaps a more sensitive part in the same speech. Let me quote a couple...
- Buttner: Where was this speech made?
- Norberg: It was made before some meeting of IRE or one of the professional groups, and it was an attempt to show the progress of radio communications. In fact the title of it was, "The Role of Radio and The Growth of International Communication." It was a very well-done speech for that period, and I think it made that point very well. But there are some things that must have been in the background that I would like to get at.
- Buttner: All right.
- Norberg: And that's the following, "The phenomenal progress and growth in international communications in recent years has been due in no small degree to the systematic manner in which research and engineering study has been organized and carried out by the communications interest." Now, was this the research you were talking about in Bell Labs?
- Buttner: Our own research. We had a certain amount, we were... What's the date now?
- Norberg: This is 1930. What kind of research was ITT doing?
- Buttner: Well, they had laboratories in Paris and London and by that time we had taken over the Western Electric and they had the very strong, very strong communication group in London on transmission. They had a group of competent people in Paris, in the laboratories there that turned out important developments. Just happened that some of the work in the Paris laboratory resulted in a patent that proved to be a fundamental patent in radar. We had a patent which covered the A scan, and we didn't realize that when we were working in this patent. The United States government has been using this patent all along, so we made claims upon the government, and then they recognized the validity of the patent, but changed their

- Buttner: approach. The government agreed that the patent covered some fundamental aspects of radar, but claimed the patent was paid for in the course of contract work. The work was done by Gloess in Paris. The United States government sent people over to France to try to find out if the work was financed in any way by the government. When they found that it was not, why then they said we'll pay you royalty in the future, and a good royalty. No, we don't want that, we want pay for past infringements. So it went on and on and on. And we finally got a number of million dollars settlement.
- Norberg: The speech continued, "Progress in the future may be assured only by continuation of the broadminded policies which have proved so successful in the past." Which broadminded policies?
- Buttner: The support of research. You see, appreciable amounts of money to support development, research, even though at that moment no immediate application is apparent.
- Norberg: So this is still all internal assessment?
- Buttner: Well, I think it was also true in any of the other places, because the thing is that if we didn't have such broadminded policies it would have been a long time before, for instance, the transistor technology had been developed. The time that Kelly was supporting it strongly, it seemed a very long shot.
- Norberg: But the next paragraph hits a crucial point, "In order to justify these policies the communications interests must have reasonable assurance that they will be permitted to work out international communication problems along economic lines, free from artificial restrictions which foster wasteful competition with its attendant losses in revenue and ultimate deterioration of the communication services themselves." Was there some kind of development of policies going on? In the background of all this?
- Buttner: Well, we had this. RCA had a monopoly. They had contracts with practically all the countries, Norway, England with Marconi, France with Radio-France, [German] Reich with Telefunken and ITT had a pretty tough job getting in there at all. The only way you could get in was go and offer something better than they had, a bigger cut on the split of the money. So it was very obvious here, the government sits there and let the American companies compete. I had the assignment of getting some of communication contracts and I negotiated one in Norway and Hungary and one with the Vatican.
- Norberg: Can you tell at least the details of one of those? How one went in and assessed a country, assessed the cost of putting in a system?

Buttner: We had a pretty good idea what the total amount of traffic was. We knew RCA totals. Competitors approached these countries without a fundamental economic justification, because you were just going to try to get part of the gravy. And with having a profound faith in the growth of communication, you figure if you just get in there to start with, he may have to take some losses for a while, sooner or later it'll pay off, and that's what had proved to be the case.

Norberg: Was RCA finally beaten out?

Buttner: Well, no, I wouldn't say they were beaten out. But we don't have that kind of competition.

Norberg: I wonder why not.

Buttner: ITT have and have cable circuits, laid some cables, but we don't have any transoceanic circuits, as I recall it. I doubt very much if we have any transoceanic wireless circuits anymore, they have cables, of course they're bigger and faster. Then another thing where ITT has really made quite an impression, they've been done very well in the satellites. I don't want to say without knowing the numbers, but they have a very substantial position in the supply of these earth stations all around the world. So they've maintained their position in that respect.

Norberg: How did research within ITT increase or decrease over the years that you were with them?

Buttner: Well, that's one of the unfortunate things. That during the Depression it was almost shut off. And that's the thing that fundamentally you should not do--I wonder if I should say this or not--if you shut down research, let people go, it takes years to get over the effect. I doubt that it would occur here at Hewlett-Packard. Since I've been here at Hewlett-Packard, there were brief periods of diminished sales. During those times management just held the reins a little tighter, but did not dismiss employees. Instead a day per week was cut from the work week. No new employees were hired, but competent research workers were not laid off.

In '32, the Depression, the only income that ITT had was derived from Cuban telephone company. ITT couldn't borrow a dime in the United States. Behn's extraordinary ability as a financier enabled ITT to carry out upstream financing in Holland and Switzerland, and thus saved the company. But his best friends in the National City Bank, and Morgan's, they wouldn't lend him a dime. And so, obviously, you couldn't carry on research in conditions like that, you just had to let the thing way, way down.

- Norberg: Was this true of others?
- Buttner: You took cuts in pay and...
- Norberg: Was this true of other companies as well? Did G.E. and Bell, for example, give up their research facilities?
- Buttner: Well, the telephone company had never been really in any serious straits. They may have dropped a few telephones here and there, but I'm pretty sure the answer is no. And I won't say anything about G.E. because I don't know.
- Norberg: During this period did you know a man by the name of George Lefitte?
- Buttner: Very well.
- Norberg: Can you tell me about him? I have another question to ask about him too.
- Buttner: Well, George Lefitte, I guess, I don't know where he started out. I guess he was with Kolster-Brandes the first time I ever met him in the East. ITT acquired some of Kolster's patents through Federal and then there was a company in England which Brandes--no, I guess it was in Jersey, and that's the first time I ran into George Lefitte. Then I knew him much better when he was the manager of the Federal, manufacturing Federal Telegraph Company in Newark, New Jersey.
- Norberg: That's all right. Do you remember the association between him and Sosthènes Behn?
- Buttner: Well, only that of Behn's real concern about anybody who was in trouble. He had some serious illness, so Behn, as was characteristic with him, sent his own doctors to see him and evidently Lefitte recovered. I guess he had some real fancy bill as a result of that. I remember him commenting on that. But I don't think there was any special relationship.
- Norberg: Was it easy to talk up to Behn, to criticize a proposal he may have had?
- Buttner: Well, if you did it right. Very difficult to refuse an assignment. If you declined an assignment, one might just as well quit. He had very, very definite ideas, and I learned to work with him very well over the years and got away with plenty for that reason. To answer your question, I can do it in more words if you want. I ran this British company which started there in the glowing days of '28, '29. They were going

Buttner: to have a marine radio company. We were going to transmit telephones to the transatlantic liners and put telephone stations in the cabins which in some cases were equipped with telephones and we had telegraph.

Marconi, the British Marconi, had a virtual monopoly and were in control of the British marine communication field. ITT engaged a retired British Admiral, in charge of ITT's marine effort. He knew little communication, but he could sit by a bottle of whiskey and drink the entire contents without change of his expression. I was just amazed at the man. He was quite a dignified man because of his naval connections. And then after the crash, ITT management found this company losing 50,000 pounds per year. Something had to be done at once. So, I was called by Behn over the telephone, he was in Switzerland, we were just going home. We were going to the dock, Cherbourg, my wife and a couple of the trunks were all ready to go home and then we got this telephone, and he said, "I want you to go over and run this company." He said, "It's lost a lot of money." I said, "Colonel, I think it's entirely wrong, as the company concerned is a British company. The British have great pride in their merchant marine. If we have a British marine company being run by an American, the results may be unfortunate." I said, "I just don't think it would be right at all." I said, "We'd make a big mistake if we do that." And so, he took that okay. I packed up my goods and we took the boat train and went down to Cherbourg. On the dock waiting for the ship to come in, I got this telephone call, and he said, "Buttner, I knew what I wanted to do and you talked me out of it." He said, "Now I want you to go over and run that company in London and you're going to stay there until it gets out of the red." So, I went, imagine, just down on the dock. So, anyway, I was in England for a long time.

I engaged a Scotchman, a real Scotch shipbuilding man, who's had the knowledge of all the ship owners et cetera. And I did not appear in the ship owners office ever. We got contracts, he was the one who always did it, I made him Joint-Managing-Director which is something done in England. So, while I might have run the company, I certainly kept a very low profile. So that worked. So then when we made money, we made a little money and I called Behn up on the transatlantic phone and I said, "You remember you said that I was going to stay there till this company's out of the red?" And he said, "Yes, I do." And he said, "How long's it been out of the red?" "Six months." "Okay, get yourself a nice cabin on the Queen Mary and come home." And that's the way I got away with that one. But turning down the first assignment was serious.

Buttner: So later he calls me to his office and said that he was going to appoint me the managing director of the Kolster-Brandes, a radio company, home receivers and later T.V. He said, "Go home and talk it over with your wife." We were living in England. I said, "I don't have to go home and talk to my wife. I tell you now." I said, "I don't think it would be the right thing to do at all." I said, "Selling is the whole thing in this radio business. And you're going to sell English radio sets to Englishmen," I said, "An American doesn't belong in this picture." I said, "I don't know a damn thing about selling to begin with. I'm just as smart as the next one, but the guy you just fired just lost 100,000 pounds. Before I learn the business, you'll lose another 50,000 pounds." And he said, "Go on, I don't want to talk to you." And that, never took it up again. However, he never held it against me.

During World War II, General Sarnof had been appointed as assistant to the Chief Signal officer. The Chief Signal officer was very friendly to Behn. He said, "ITT should have somebody on my Council." So there was an ideal man there named Quinn, who had been in the Reserve and was a Colonel in the Reserve. So he said, "Why don't we put Colonel Quinn on your staff?" So Quinn took a physical examination and couldn't pass because of defective teeth. My name was suggested. I could not pass the hearing tests. Next it was decided I was going to be appointed as resident Vice-President in Washington. So I said, "Well, that's not a good assignment, I'll tell you why. I don't hear well. In Washington you're supposed to be listening in keyholes, and all the little things like that if you're going to be successful. And the ITT Vice-President has to get around and visit and give parties and I don't like to do that, and if you don't like to do something, you never do it well. Very bad choice." So he said, "Okay." But ordinarily if people would refuse an assignment, they were in deep trouble.

Charles V. Litton

Norberg: One thing that we have not discussed is Charlie Litton. How did you meet Charlie Litton?

Buttner: I guess I met him through Pratt, through Haraden Pratt. Haraden Pratt is an IEEE fellow and former President of IEEE. Litton worked for Federal, and when ITT bought Federal, they were going to move to New Jersey. Charlie had worked before for the Bell Laboratories for a brief period and the Eastern climate didn't agree with his health, and he came back here.

Buttner: That's how he came to work with Federal. He was the sort of artist that did all the great tricks with glass and had an outstanding, great knowledge of metals, working metals, and vacuum, and he realized the role of high vacuum long before others in the vacuum tube field. So Federal wanted him to go to New Jersey and he wasn't anxious to do that, so he gave a salary figure which was quite high. And Lefitte was then running Federal. He said, "My god, no glassblower is worth that."

Charlie and I were great friends for a long time. I used to stay there at his home in San Carlos, and when the Littons visited New York, they lived in my home. Litton purchased from Federal the leftovers from Federal's move to New Jersey and that was the nucleus of the first Litton Industries, making glass-working machinery, certain vacuum equipment and vacuum tubes.

Federal had a war contract with the Navy to make a certain vacuum tube called 15E. The 15E was the heart of the Navy gun-laying radar, most important during the Pacific war. And that radar had a very important role in the famous night battle of the Solomon Islands. In attempting production of 15E's, Federal experienced failure after failure. So I called Charlie up on the phone and said, "Charlie, we're in a serious situation here, it has grave military consequences, goes far beyond the company." And I said, "I know you can produce these vacuum tubes. Will you come East and help us out?" And Litton replied without any hesitation, "Sure. Get somebody to run my place in San Carlos and I will join you at once." We sent a man to San Carlos to manage Litton's machinery factory. Litton set up a production line in New Jersey, and no further trouble was encountered with the 15E.

Norberg: Who was the man you sent?

Buttner: Oh, his name was Copelin, Jack Copelin. He was an accountant, an Englishman. He did all right while he was here.

Norberg: What can you tell me about Charlie beyond that though?

Buttner: Well, I guess nobody knew more than he did about the role of high vacuum in electronic phenomena. That's why he was so successful in the radar magnetrons. The fact that a high vacuum in a magnetron was impossible unless it had been an objective of original design. The process of the outgassing routines was inherent in design and resulted in the best magnetrons made anywhere. That was sort of the foundation of the Litton Company.

- Buttner: He found the Peninsula area too crowded so he moved the plant to Grass Valley. He bought an old hospital and reconstructed it personally. He must have laid acres of asphalt tile. He had great ability, a genius type. He visualized things mentally. He didn't have to make a lot of drawings, he could just start out and make something and seeing it all in his mind.
- Norberg: Thinking back to the time before you became associated with Hewlett and Packard, did you know Fred Terman?
- Buttner: Yes.
- Norberg: In what capacity?
- Buttner: I used to see him at Stanford.
- Norberg: For what purpose?
- Buttner: During those times we were talking about the klystron and radar generators. It may have been at that time 'cause about the same time I arranged with Charlie to build klystrons for the French government.
- Norberg: Now, one question that I didn't ask, and that is, did the Depression cause the consolidation of a number of radio companies? Do you have any general feeling that this was taking place?
- Buttner: Yes. There were also numerous failures during that period.
- Norberg: If you look at the date structure, most of the present companies date from '34, '35, '36, after the really difficult period...
- Buttner: Probably rather than consolidation, some of them just sort of folded up entirely.

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